

## IDENTITY AND STATUS IN SINGAPORE OF A NATURALISING *SENNA* SPECIES

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### INTRODUCTION

The genera *Cassia* sensu stricto, *Chamaecrista* and *Senna* together make up *Cassia* sensu lato. This group is well-circumscribed as a monophyletic clade within the paraphyletic tribe Cassieae, subfamily Caesalpinioideae in the family Fabaceae—this phylogeny being supported by molecular and morphological cladistics (Herendeen et al., 2003). Singapore has no native members of these genera; most of them were introduced via cultivation. Of the 15 *Senna* species recorded in Chong et al. (2009), five are known to have naturalised locally: *Senna alata* (L.) Roxb., *Senna hirsuta* (L.) Irwin & Barneby, *Senna obtusifolia* (L.) Irwin & Barneby, *Senna occidentalis* (L.) Link, and *Senna tora* (L.) Roxb. A sixth species, *Senna spectabilis* (DC.) Irwin & Barneby, is considered a casual species. Here we report the naturalisation of another species, *Senna surattensis* (Burm.f.) Irwin & Barneby, and explore its possible confusion with *Senna sulfurea* (Collad.) Irwin & Barneby.

### PAST RECORDS

*Senna surattensis* and *Senna sulfurea* were recognised by older revisions in the Americas (Irwin & Barneby, 1982) and in the Flora Malesiana (Hou et al., 1996) as separate, but very similar, species. According to the treatment in the Flora of Australia (Randall & Barlow, 1998), however, they were considered as two subspecies of *Senna surattensis* (i.e. ssp. *surattensis* and ssp. *sulfurea*, respectively) instead. All these authors agree that *Senna surattensis* be distinguished from *Senna sulfurea* by its shorter leaves, but possession of more pairs of smaller leaflets per leaf and hence shorter interfoliolar segments of the rachis, shorter petals, and shorter stipes of seed pods.

A search of the Singapore Botanic Garden Herbarium (SING) specimen records shows none of *Senna surattensis*, or its synonyms. However, there are three *Senna sulfurea* specimens. The Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU) contains another five records of species determined as *Senna sulfurea* and four collected as *Cassia surattensis*, a synonym of *Senna surattensis*. All these specimens are possible candidates for *Senna surattensis* instead (Table 1).

Keng (1990) listed *Cassia surattensis* Burm.f. (synonym of *Senna surattensis*), but this identity was probably misapplied to *Senna sulfurea*. Keng (1990) described the species as being “like *Cassia biflora*, but having fewer pairs (4–6) of leaflets... and larger flowers and larger pods (12–20 cm long)”. This description appears closer to that of *Senna sulfurea* rather than *Senna surattensis*. (Incidentally, *Cassia biflora* Mill., described by Keng [1990] to be “closely allied to *Cassia surattensis*”, is a synonym for *Aeschynomene brasiliiana* (Poir.) DC., a herbaceous Central American species (subfamily Papilionoideae). *Aeschynomene brasiliiana* is very different from any member of the Cassieae, and has never been recorded in Singapore hence this entry is also likely incorrect.) While *Senna surattensis* and *Senna sulfurea* were not listed by Turner (1993) for Singapore, the checklist of vascular plants of Malaya by Turner (1995) listed *Senna sulfurea* as occurring in waste places. However in this instance, it cannot be certain that the species was correctly listed because the synonym of *Senna sulfurea* was mistakenly given as *Cassia surattensis* Burm.f., and not *Cassia surattensis* auct.non Burm.f. Boo et al. (2006) listed only *Senna surattensis*, and an examination of the photograph shows that this identification is likely to be correct.

### DETAILS OF OBSERVATIONS

Measurements of the SINU sheet specimens were congruent with the descriptions provided by the various floras (Irwin & Barneby, 1982; Hou et al., 1996; Randall & Barlow, 1998) for *Senna surattensis* (Table 2). As the SING specimens were much older, floral parts have been lost, and were not reliable for measurements, but leaf and leaflet dimensions, as well as the length of the fruit, were congruent with the descriptions for *Senna sulfurea*.

Table 1. Singapore collections of putative *Senna surattensis* or *Senna sulfurea* specimens, in chronological order, deposited in the Herbarium, Singapore Botanic Gardens (SING; with bar code no.) and Herbarium, Raffles Museum of Biodiversity Research, Department of Biological Sciences, National University of Singapore (SINU; with accession no.).

S/No.	Accession/Bar Code No.	Collector	Name on Specimen Label	Year	Locality
1.	SING 0044590	J. S. Goodenough	<i>Senna sulfurea</i>	1890	Sungei Murai
2.	SING 0044591	H. N. Ridley	<i>Senna sulfurea</i>	1897	Singapore Botanic Gardens (Cultivated)
3.	SING 0044589	Mahmud	<i>Senna sulfurea</i> ssp. <i>glauca</i>	1979	Grange Road
4.	SINU 2007005844	Siti Dahlia	<i>Cassia surattensis</i>	1989	Kent Ridge Campus
5.	SINU 2007005846	Siti Dahlia	<i>Cassia surattensis</i>	1989	Kent Ridge Campus
6.	SINU 2007005845	I. M. Turner	<i>Cassia surattensis</i>	1993	South Buona Vista Road, off Vigilante Drive
7.	SINU 2007005848	Unknown	<i>Senna sulfurea</i>	1996	Pulau Subar Laut
8.	SINU 2007005849	Unknown	<i>Senna sulfurea</i>	1996	Pulau Subar Laut
9.	SINU 2007005850	Unknown	<i>Senna sulfurea</i>	1996	Pulau Subar Laut
10.	SINU 2007005851	Unknown	<i>Senna sulfurea</i>	1996	Pulau Subar Laut
11.	SINU 2007004810	C. P. Lim	<i>Cassia surattensis</i>	1998	Lower Kent Ridge Road (Cultivated)
12.	SINU 2007005847	K.-x. Tan	<i>Senna sulfurea</i>	2003	Sungei Punggol

Table 2. Measurements of plant parts between *Senna surattensis* and *Senna sulfurea* from various floristic descriptions compared to recently collected local specimens.

Information Sources	Randall & Barlow (1998)		Hou et al. (1996)	
	<i>Senna surattensis</i> ssp. <i>surattensis</i>	<i>Senna surattensis</i> ssp. <i>sulfurea</i>	<i>Senna surattensis</i>	<i>Senna sulfurea</i>
Leaf length (cm)		5–15(–20)	15	5–15
Leaflet number (pairs)	6–10	4–6(–7)	6–9	4–6
Leaflet spacing (mm)		15		Not applicable
Leaflet colour	discolourous	concolorous		Not applicable
Leaflet length (mm)	(20–)25–45(–50)	40–70(–100)	25–40	50–100
Leaflet width (mm)		10–20	10–17	20–40
No. of leaflets with glands		2–5	2–3	2–3(–4)
Peduncle length (mm)		20–60	25–50	30–100
Pedicel length (mm)		15–30	10–20	10–30
Petal length (mm)	16–24	(10–)15–30	15–20	15–20
Fruit length (cm)		8–15	7–10	12–17
Fruit width (mm)		10–15	10–15	15–18

Table 2. (continued)

Sources	Irwin & Barneby (1982)		Observations	
	<i>Senna surattensis</i>	<i>Senna sulfurea</i>	SINU and field specimens ( <i>Senna surattensis</i> )	SING specimens ( <i>Senna sulfurea</i> )
Leaf length (cm)	8–18	14–30	9–13	~16
Leaflet number (pairs)	6–10	4–6(–7)	7–8	5–6
Leaflet spacing (mm)	9–15(–17)	13–33	9–14	17–24
Leaflet colour	Not applicable	Discolorous	Not applicable	Not applicable
Leaflet length (mm)	(20–)25–45(–50)	(40–)45–85	36–44	47–67
Leaflet width (mm)	(8–)10–18(–20)	20–38	15–18	21–28
No. of leaflets with glands	1–3	(1–)2–4	1–3	NA
Peduncle length (mm)	(25–)30–80	30–90(–130)	34–55	NA
Pedicel length (mm)	16–25	22–42	17–25	NA
Petal length (mm)	(16–)18–24	(20–)23–30	20–24	NA
Fruit length (cm)	7–10	12–17	6–10	10–15
Fruit width (mm)	11–15	13–18	12–14	11–13



Fig. 1. Spontaneously occurring *Senna surattensis* along a drain edge near Buona Vista MRT station (main photograph) and dried fruit (inset). Scale bar in cm and mm. (Photographs by: Chong Kwek Yan).



Fig. 2. One of many *Senna surattensis* plants growing on roadside lawns along Simei Avenue near Changi Hospital; this individual was reproductive before reaching 1 m tall. (Photograph by: Chong Kwek Yan).



Fig. 3. Spontaneously occurring *Senna surattensis* competing with other naturalized exotic species, such as *Ptychosperma macarthurii*, *Acacia auriculiformis*, and *Mikania micrantha*. (Photograph by: Chong Kwek Yan).

We made collections of spontaneously occurring individuals that were suspected to be either of these two species at two sites. In 2007, a stand of individuals was removed from the drain immediately behind the bus stop no. B11181 along West Commonwealth Avenue, but it could not be confirmed if they were cultivated intentionally, or spontaneously occurring. Later, another stand of the same species grew spontaneously along the same drain further away from the bus stop (Fig. 1). These were the first individuals that were collected for our measurements. Many small individuals of the same species were also observed along Simei Avenue, near Tampines South Flyover, and Changi General Hospital. One plant was observed to be flowering even before reaching a height of 1 m (Fig. 2). These are suspected to be offspring from a larger individual flowering and fruiting profusely nearer the expressway flyover (Fig. 3). This was the second site for collection and measurements. In addition, other cultivated individuals of the species in question were collected opportunistically and measurements were made. All the measurements showed that these species were similar to the SINU herbarium specimens (Table 2), and hence are *Senna surattensis*.

In summary, *Senna sulfurea* was introduced and cultivated earlier in Singapore, but was likely to have lost popularity with horticulturists, and naturalisation of this species did not occur. *Senna surattensis* could have been preferred over *Senna sulfurea* from the 1980s onwards, and have been ubiquitously planted as wayside shrubs. It was only a matter of time before the profuse flowering and fruiting of so many individuals led to the escape and naturalisation of *Senna surattensis*. It is also not known how the seeds are dispersed, as they do not seem to have specialised structures. As yet, *Senna surattensis* is not likely to be a threat to other plant species, and indeed appears to be a poor competitor against other more aggressive exotic species.

The recently published checklist of the total vascular flora of Singapore (Chong et al., 2009) lists 259 species of legumes (Fabaceae), the majority of which are cultivated (181 species, 69.9%) or exotic (190 species, 73.4%), and many of these species have become naturalized (46 species). We can expect the list of naturalised legume species to continue to expand over time, as more alien species are introduced for cultivation. Further observations of the spread (or the failure to spread) of *Senna surattensis* and other species may yield an opportunity to understand the invasiveness of introduced legumes.

## CONCLUSIONS

*Senna sulfurea* was once cultivated locally, but *Senna surattensis* is the species that is now commonly planted. *Senna surattensis* is likely to be in the early stages of naturalisation, and should be closely monitored for invasiveness, and ecological insights into naturalisation of alien legumes.

## ACKNOWLEDGEMENTS

We would like to thank Chua Keng Soon and Serena Lee for providing access to records of *Senna sulfurea* and *Senna surattensis* in the Singapore Botanic Gardens Herbarium (SING) and Herbarium, Raffles Museum of Biodiversity Research, National University of Singapore (SINU), respectively.

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